

15th Space Activity and Society (16th Symposium) (E5.)

Social Benefits of Space Spin-Offs (1.)

Exclude Poster: yes

Student(student: no)

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## DOWN-TO-EARTH BENEFITS OF SPACE EXPLORATION: PAST, PRESENT, FUTURE

### Abstract

A ventricular device that helps a weakened heart keep pumping while awaiting a transplant. A rescue tool for extracting victims from dangerous situations such as car wrecks. A video analysis tool used to investigate the bombing at the 1996 Olympics in Atlanta. A sound-differentiation tool for safer air traffic control. A refrigerator that runs without electricity or batteries. These are just a few of the spin-offs of NASA technology that have benefited society in recent years.

Now, as NASA sets its vision on space exploration, particularly of the moon and Mars, even more benefits to society are possible. This expansion of societal benefits is tied to a new emphasis on "technology infusion" or "spin-in." NASA is seeking partners with industry, universities, and other government laboratories to help the Agency address its specific space exploration needs in five areas: (1) advanced studies, concepts, and tools; (2) advanced materials; (3) communications, computing, electronics, and imaging; (4) software, intelligent systems, and modeling; and (5) power, propulsion, and chemical systems. These spin-in partnerships will offer benefits to U.S. economic development as well as new products for the global market.

As a complement to these spin-in benefits, NASA also is examining the possible future spin-outs of the innovations related to its new space exploration mission. A matrix that charts NASA's needs against various business sectors is being developed to fully understand the implications for society and industry of spin-in and spin-out. This matrix already has been used to help guide NASA's efforts to secure spin-in partnerships.

This paper presents examples of NASA spin-offs, discusses NASA's present spin-in/spin-out projects for pursuing partnerships, and considers some of the future societal benefits to be reaped from these partnerships. This paper will complement the proposed paper by Frank Schowengerdt on the Innovative Partnerships Program structure and how to work with the IPP.

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**Abstract**

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# Down to Earth Benefits of Space Exploration: Past, Present, Future

**Vernotto McMillan**

Manager

Technology Transfer Program

NASA Marshall Space Flight Center

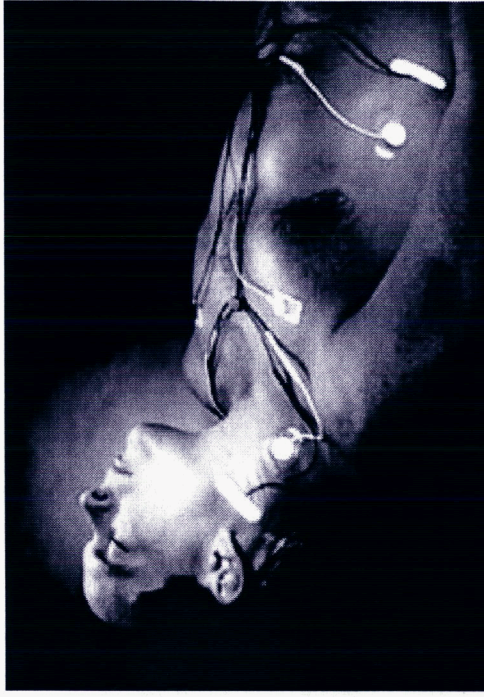
October 18, 2005



# The Past: Apollo



- Significant scientific return
  - Demonstrated U.S. technological and economic abilities
  - Technology transfer



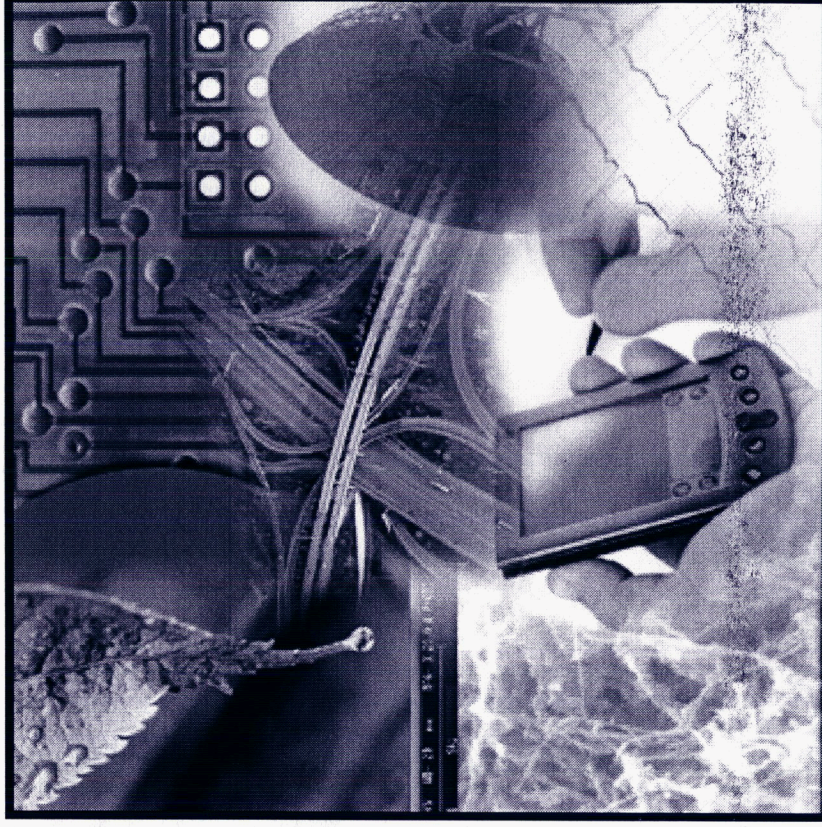
Impedance cardiography (ICG)



# The Present: Shuttle, Hubble, etc

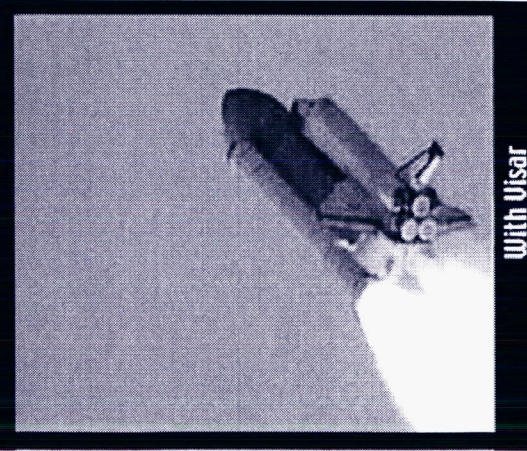
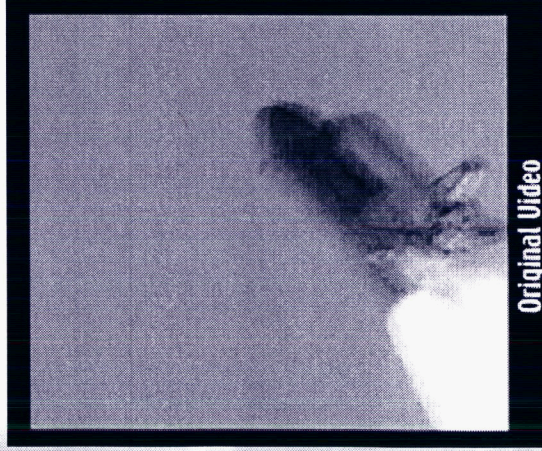


- Spin-outs continuing
  - Medicine
  - Energy
  - Transportation
  - Manufacturing
  - Environmental





# The Present: Spin-Out Success



- **VISAR**

- Based on NASA expertise related to improving telescope and weather satellite images
- Developed to help the FBI investigate the bombing at the 1996 Olympics in Atlanta
- Now available as part of Intergraph's Video Analyst<sup>®</sup> System



# The Present: Spin-Out Success

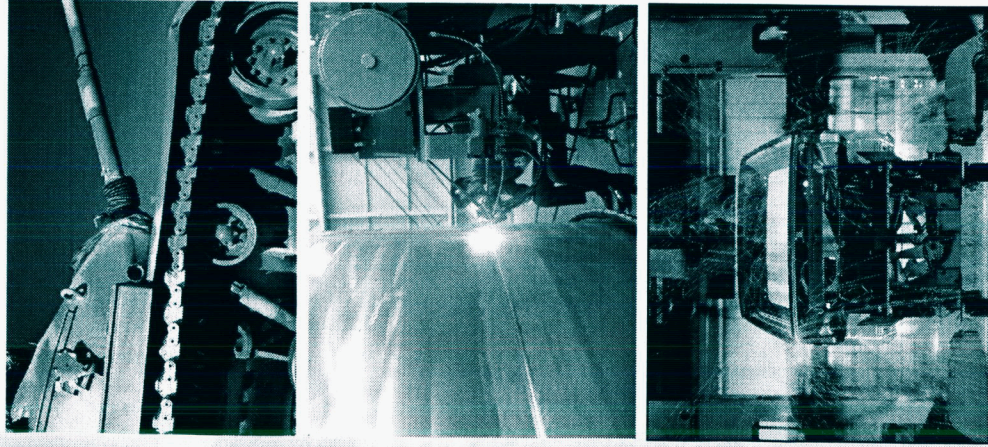


- **Lifeshears**

- Used to rescue people from dangerous situations such as car wrecks and other disasters
  - 1995 Oklahoma City bombing
  - 2001 World Trade Center attack
- Relies on same power source used to separate solid rocket boosters from the Space Shuttle
- Lighter, cheaper, and easier to use than traditional rescue equipment



# The Present: Spin-Out Success



- **Thermal-Stir Welding (TSW)**

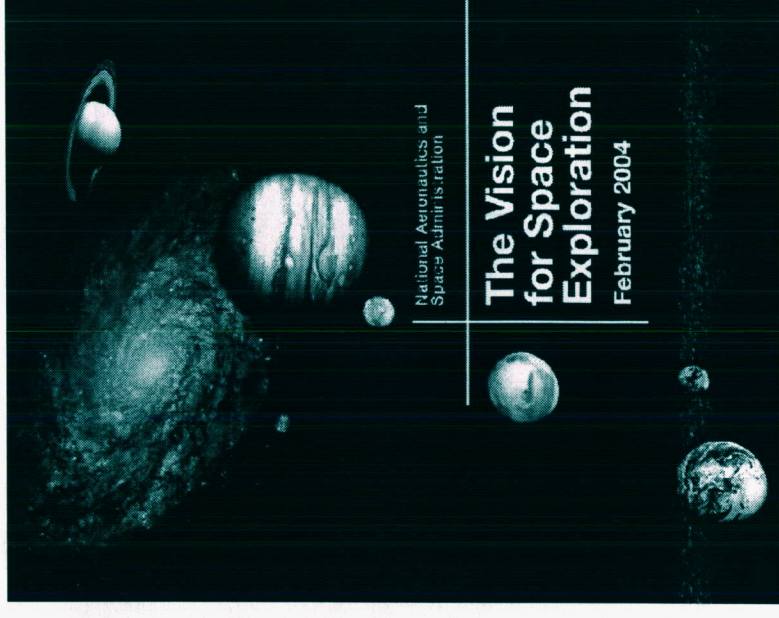
- MSFC partnership with Keystone Strategic Enterprises
- MSFC providing TSW equipment, facilities, and expertise
- Keystone providing design work, materials for testing, and expertise
- Goal: Expansion of TSW's capabilities with benefits for NASA, military, and automotive applications



# The Future: Space Exploration



- Human and robotic missions to the moon, Mars, beyond
- Critical technical challenges
  - Materials, structures
  - Communications, computing, imaging
  - Software, intelligent systems
  - Power, propulsion





# Meeting Technical Challenges



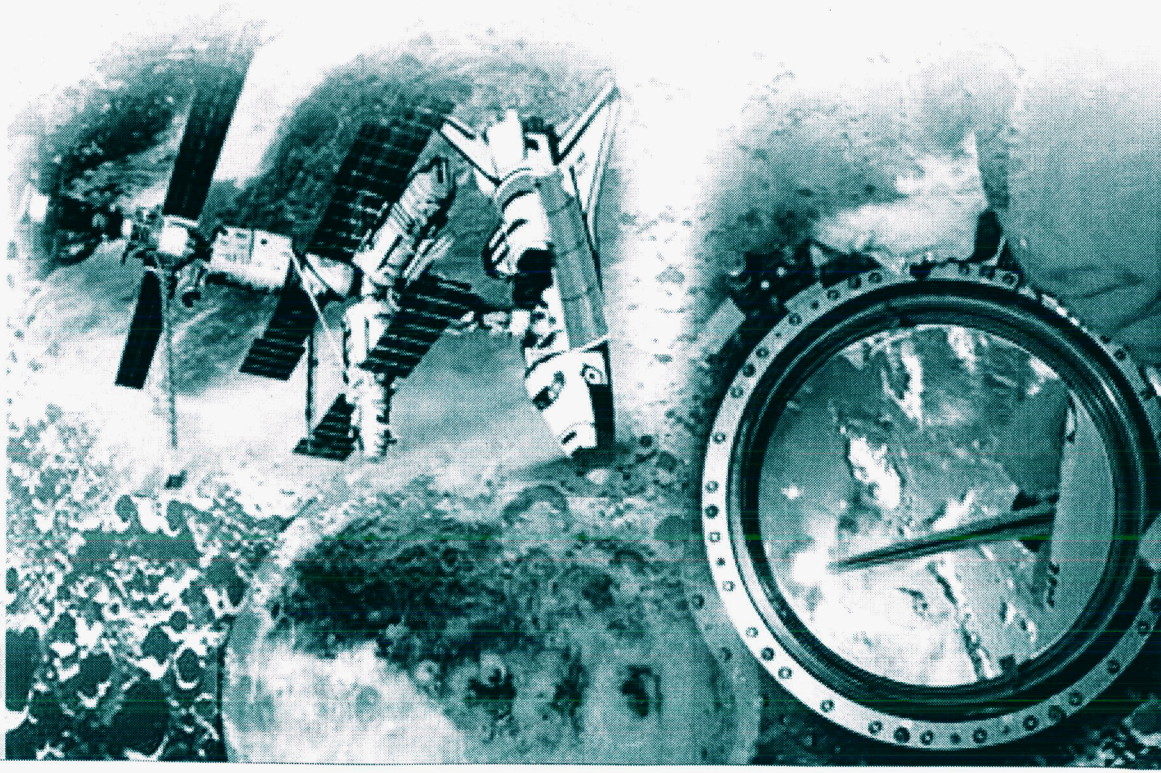
- Directly fund internal R&D
- Buy externally developed technology
- Partner/Collaborate (spin-in)
  - Benefit from others' inventions, facilities, expertise
  - Aerospace **and** nonaerospace partners
    - Industry, academia, other gov't labs
  - Innovative Partnerships Program
    - Identifying dual-use opportunities



# Future Opportunity: Air Quality Devices



- **NASA need:**
  - Predicting/Mitigating effects of space environments on materials, electronics, other spacecraft systems
- Vacuum
- Extreme temperatures
- Atomic oxygen
- Ultraviolet radiation
- Charged and neutral particle radiation
- Meteoroids and orbital debris
- Dust and contaminants

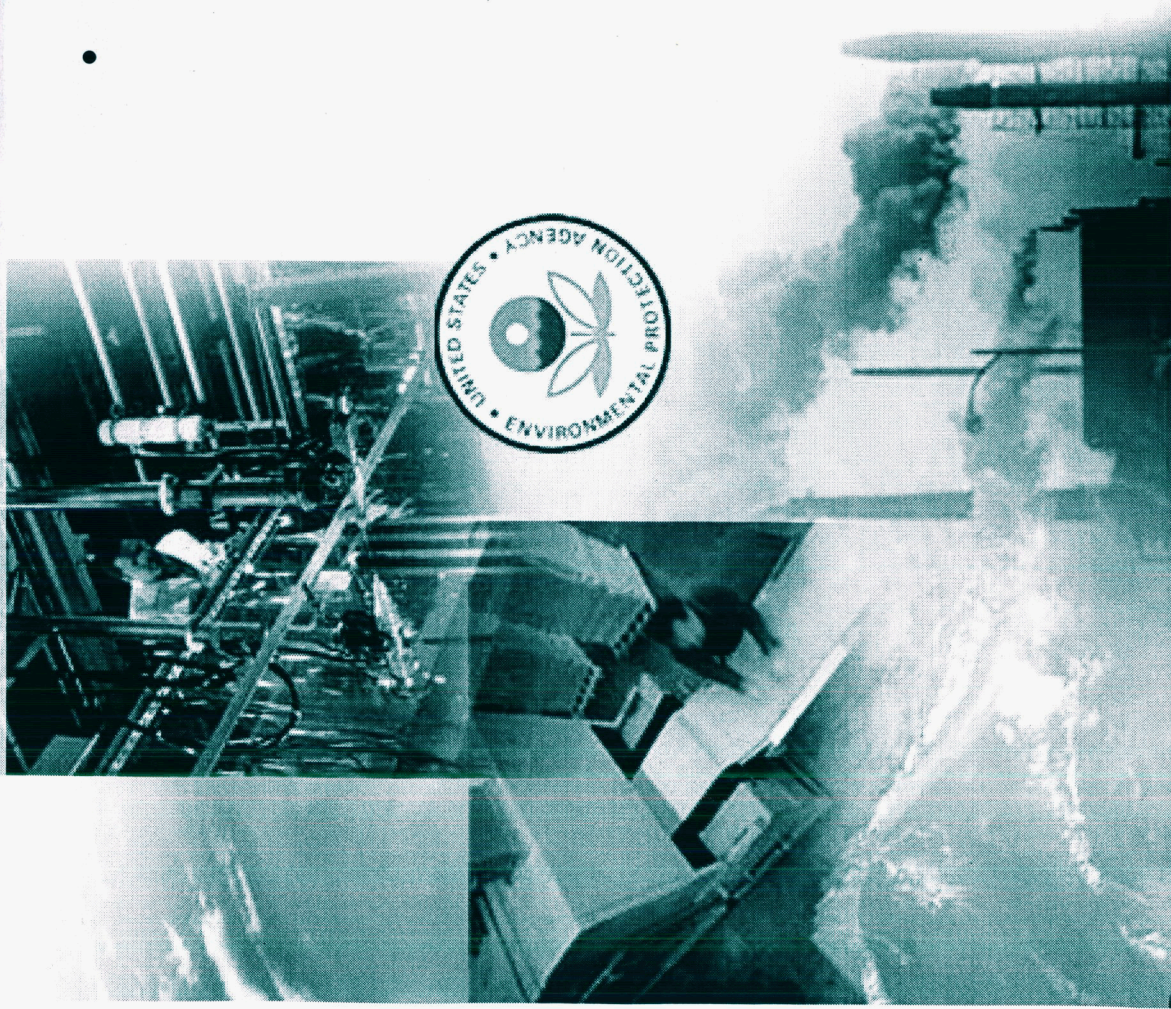
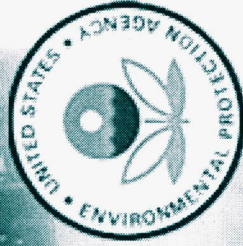




# Future Opportunity: Air Quality Devices



- **Potential technology sources**  
(spin-in):
  - Clinics and research labs
  - Filtration companies
  - Aircraft manufacturers
  - U.S. Environmental Protection Agency

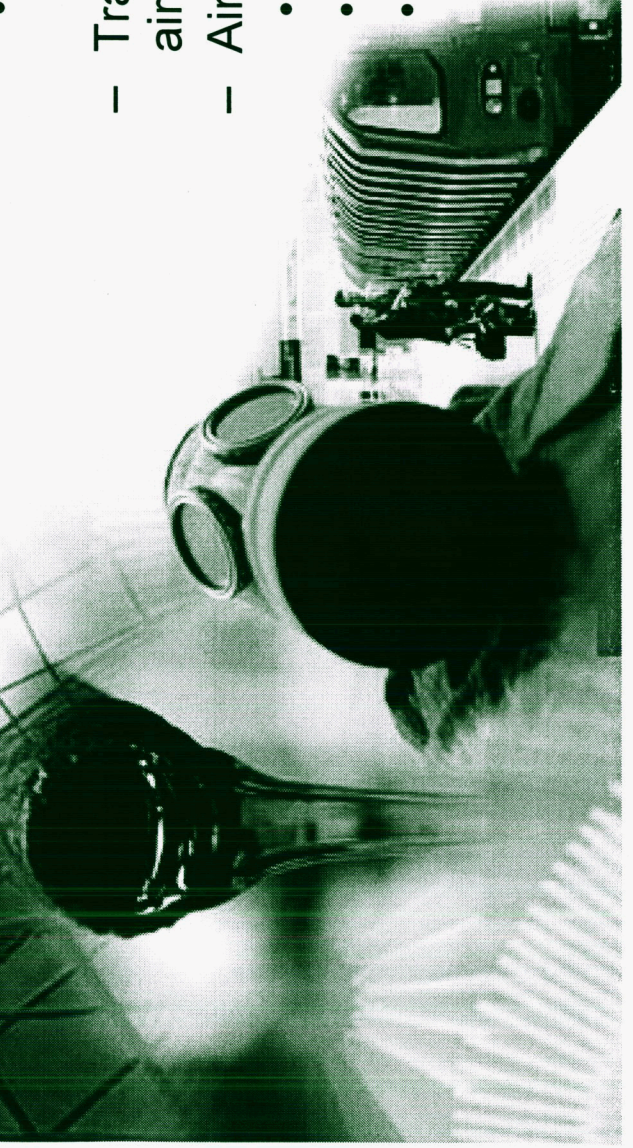




# Future Opportunity: Air Quality Devices

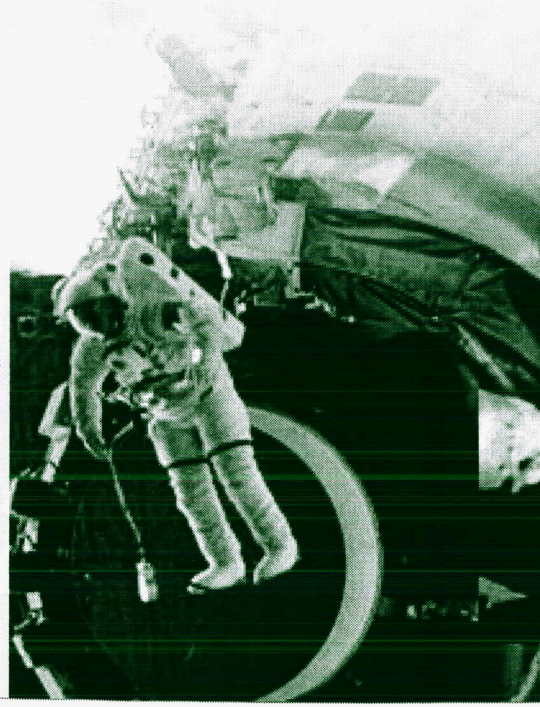


- **Future applications (spin-out):**
  - Harsh industrial environments
    - Power/Petrochemical plants, oil refineries
    - Paper, chemical, pesticide manufacturers
    - Painting operations, sewage treatment
    - Semiconductor, electroplating industries
  - Transportation (vehicles, aircraft)
  - Air quality control
    - Mining
    - Buildings, homes, hospitals
    - Military/Civilian safety

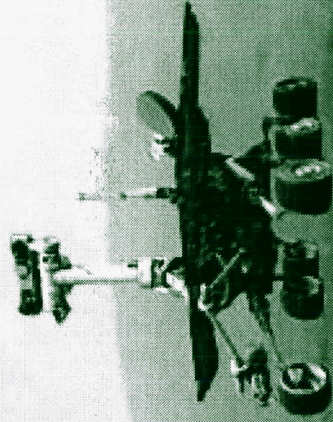
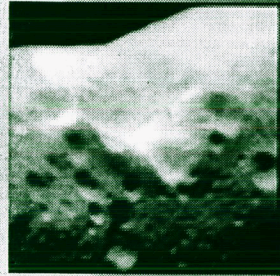




# Future Opportunity: Wireless Sensors



- **NASA need:**
  - Monitoring
    - Astronaut health, habitats, equipment, materials
  - Networking
    - Rovers, landers, personnel
  - Imaging
    - In-space system inspection





# Future Opportunity: **Wireless Sensors**



- **Potential technology sources (spin-in):**
  - Defense Department
  - Biomedical companies
  - Automotive manufacturers
  - Electronics companies





# Future Opportunity: **Wireless Sensors**



- **Future applications (spin-out):**
  - Transportation vehicles
    - Commercial aircraft
    - Automobiles (safety testing and continuous monitoring)
      - Ships
  - Environmental monitoring
    - “Smart” textiles
      - Military
      - Commercial
      - Medical





# Future Opportunity: Extreme Electronics



- **NASA need:**
  - Electronics for extreme moon/Mars environments
    - Ultra-low temps
    - Wide-ranging temps
    - Radiation tolerant
    - Single event upset (SEU) tolerant
  - Technologies for modular, expandable human and robotic systems
    - Sensors and imagers
    - Motors and actuators
    - Modular short-range radios
    - Control electronics and packaging

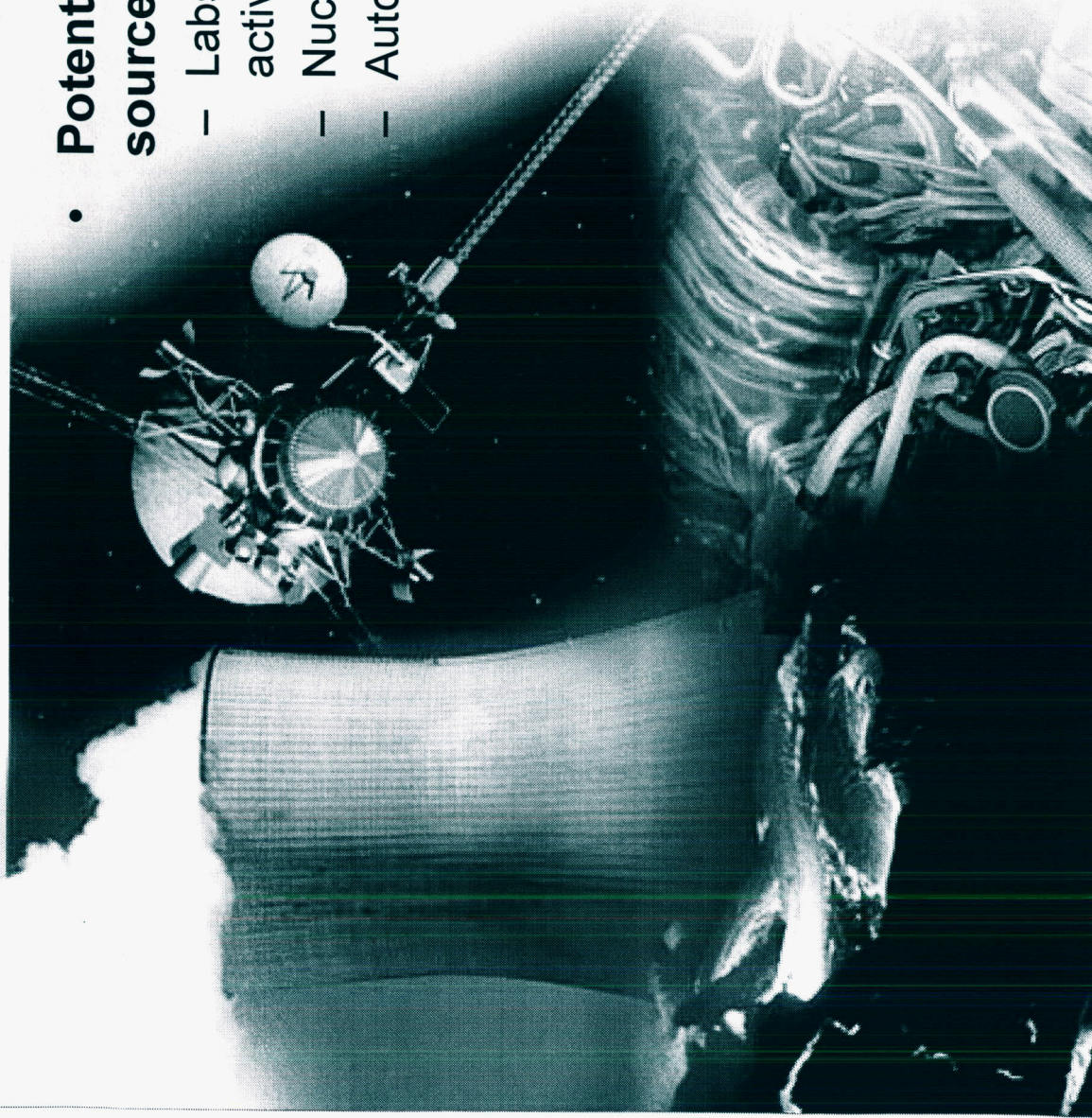




# Future Opportunity: **Extreme Electronics**



- **Potential technology sources (spin-in):**
  - Labs monitoring volcanic activity
  - Nuclear power plants
  - Automotive industry





# Future Opportunity: **Extreme Electronics**



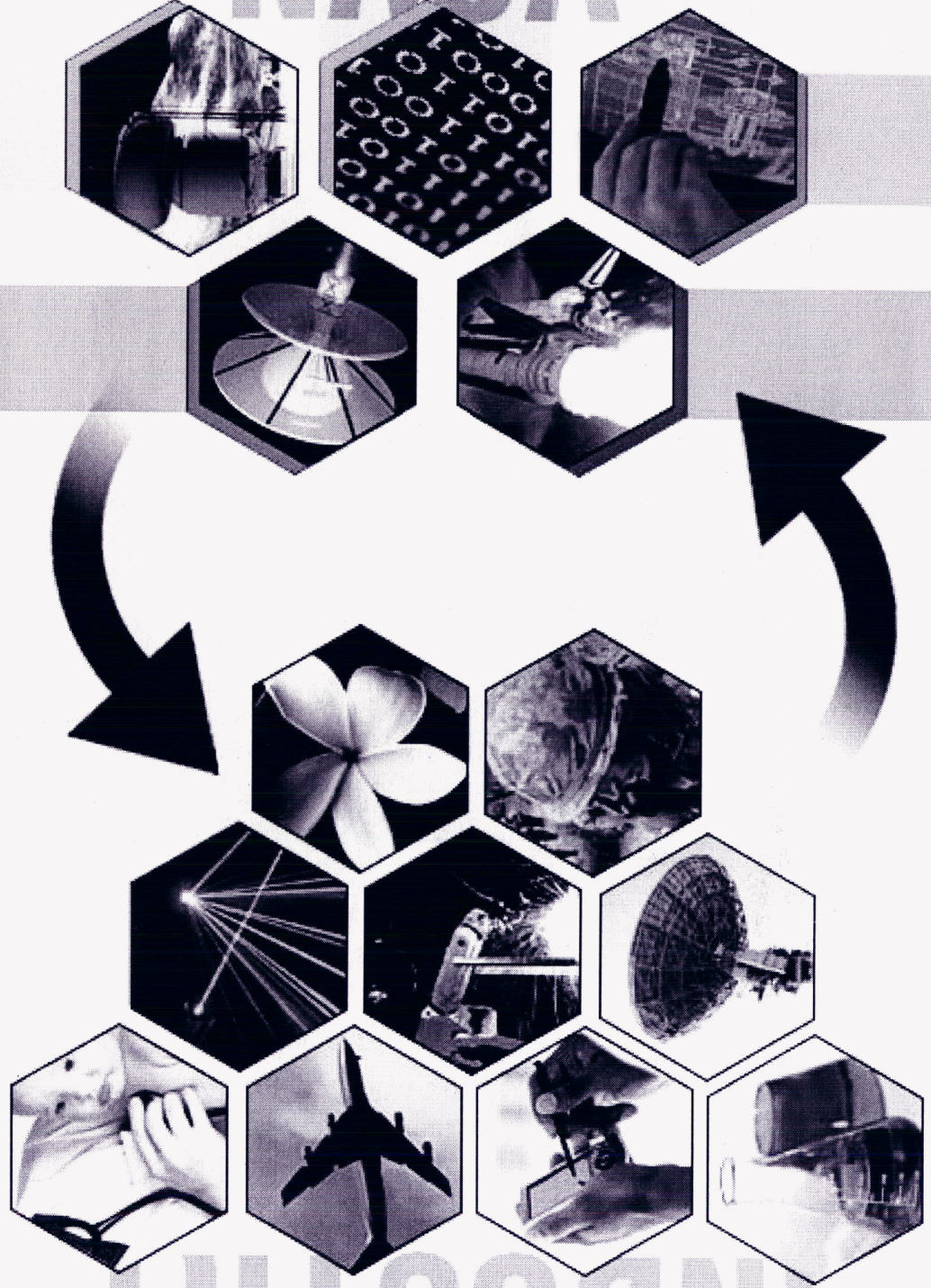
- **Future applications**  
(spin-out):

- Telecommunications
- Power generation, control, and conversion
- Nuclear and chemical plants
- Automobiles
- Avionics and aeronautics
- Micromachining/fabrication
- Geothermal research
- Forest fire monitoring





# Stimulating Ideas: Spin-In/Out Cycle





## PARTNERSHIP PORTAL

Search for

# Technology Partnership Opportunities with NASA

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+ CONTACT NASA

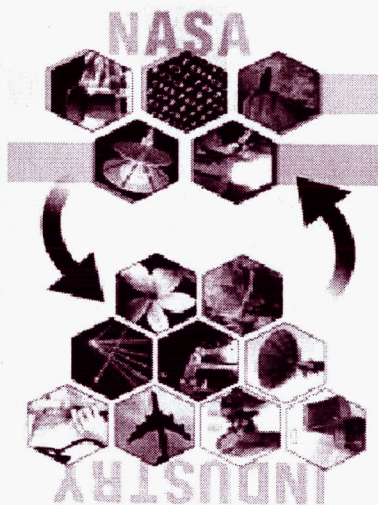
+ NEW SEARCH

+ GO TO MATRIX

If the same principles that give us detailed pictures of space could be applied to detecting cancer, is it worth a closer look?

If developing that cancer detection technology can take half the resources because of collaborative partnerships and joint development with NASA, is it a smart move for the company developing it?

You bet it is.



—NASA has many technology needs, and most technologies have multiple applications. By working jointly with NASA to develop technologies to meet their needs, companies can also meet their own product development needs—faster, more efficiently, and with less capital.

Take advantage of NASA's research and program funding to get your business off the ground, while also giving NASA the technologies it needs to reach its own goals.

### Introduction to searching for technology opportunities within NASA

In an effort to facilitate industry interest and public support for the Space Exploration Program, a Matrix has been developed that demonstrates the depth with which the technology development for the Space Exploration Program can impact wide ranging industries on Earth. It is hoped that this Matrix will stimulate ideas for spin in and spin out opportunities that will be mutually beneficial for the Space Exploration Program, private industry, other government interests, and everyday life on Earth.

#### Quick Keyword Search

Enter search term(s):

#### Successes

High Rate Digital  
Demodulator  
Partnership

#### Highlighted NASA Needs

Communications,  
Electronics, and  
Sensors



## Search

### Industry Search

- ☐ Health / Medical
- ☐ Electronics / Energy/ Photonics
- ☐ Advanced Materials / Chemicals
- ☐ Transportation
- ☐ Environmental
- ☐ Defense
- ☐ Manufacturing
- ☐ Telecommunications
- ☐ Consumer products

**SUBMIT**

### Keyword Search

Enter search term(s)

**SUBMIT**

### Category Search

Choose your category

Select Category

Select Category

Analysis Tools

Communications, Electronics, and Sensors

**Materials and Structures**

Modeling and Automation

Power and Propulsion

You have the option of searching based on:

1. industry
2. keyword
3. technology category
4. or a combination of these.

Click the "Submit" button next to your final search criterion only.

Using more search criteria will narrow your search AND may result in missed opportunities. Therefore, it is recommended that you begin with broader searches.

When entering keywords related to your technology, use broad terminology in order to gather all relevant results.

For example, enter disease rather than cancer.

**Or, browse the complete list:**

[+ View all of NASA's technology needs](#)

[+ View all opportunities](#)

[+ View all success stories](#)

This is the list of subcategories that will be searched on.



- + Expand to show all Subcategories
- Hide all Subcategories

INDUSTRIES									
TECHNOLOGY CATEGORIES	Health / Medical	Electronics / Energy / Photonics	Advanced Materials / Chemicals	Transportation	Environmental	Defense	Manufacturing	Telecommunications	Consumer Products
Materials and Structures +Expand subcategories									
Communications, Electronics, and Sensors +Expand subcategories									
Modeling and Automation +Expand subcategories									



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# Technology Partnership Opportunities with NASA

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### Contact NASA

Collaboration and general inquiries:

[partnership@gssc.nasa.gov](mailto:partnership@gssc.nasa.gov)

### Featured

### Success Stories

A Bright Idea For The  
Eye

A Coating That Cools  
And Cuts Costs

- Access the Partnership Portal
  - <http://partnership.gssc.nasa.gov>
  - Interest in using our technologies
  - Solutions to our challenges/needs